Master's Thesis of Public Health

Epidemiology of Food Preference in Korea: The Healthy Twin Study

쌍둥이 가족 자료를 활용한 한국인 식이선호도 역학 분석

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Epidemiology of Food Preference in Korea : The Healthy Twin Study

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이 논문을 보건학석사 학위논문으로 제출함

2017년 11월

서울대학교 대학원

보건학과 보건학전공

차 유 현

차유현의 보건학석사 학위논문을 인준함

2017년 12월

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Abstract

Introduction: What ones eat matters in shaping health and diseases, still little is known about its determinants. We attempted to grasp components of food preference in adult with particular focus on genetic versus environmental influences.

Materials and Methods: The Healthy Twin Study is a twin-family cohort study of Korean, involving adult twins and their first-degree relatives. Among 3500 cohort subjects, 1029 individuals participated in the food preference survey (154 complete monozygotic twin pairs, age ranged from 17 to 87, female 61.2%). There were two open questions about food preferences (distaste, fondness), and participants were asked to name food up to 3 items. Dimension/component of taste was categorized, and the food preference survey results were mapped with the pre-determined categories. General characteristics of each dimension were described by age, sex groups. Intraclass correlation coefficients (ICCs) between relative pairs were calculated. Genetic versus environmental influences were estimated by variance component model as heritability ($h2$) and shared environment effects ($c2$). Environmental sharing was further examined as sibling effects, spousal effects and current cohabitation.

Results: Food preferences were categorized into 4 groups with several subgroups; olfaction/aroma (*Olfaction*), texture/consistency (*Texture*), emotional or psychological disgust (*Disgust*), other specific food items (*Others*). Sex differences in food preference was observed for some dimensions; women reported more distaste for *meat-conventional*, *Disgust*. Age was another factor that showed a strong trend with some categories; younger people reported more about *Ol-*

faction or *Texture* preferences. Some categories showed more than moderate genetic influences; distastes for *Olfaction* and *Texture* ($h2$: 0.41, 0.48). For *Flavor* subgroups, shared environmental effect was also evident ($c2$: 0.55). Some dimensions showed no evidence of genetic influences; only shared environments explained distastes for *Offal* ($c2$: 0.33), *meat-unconventional* and *meat-conventional* (spouse ICC: 0.207, 0.308). Personal fondness showed more genetic influences ($h2$: 0.27-0.68), which is also compatible with ICCs.

Conclusion: Our findings show that food preferences in adult consist of multisensorial factors, far beyond simple taste or aroma. Olfaction, psycho-emotional influences, and touch sensation in the mouth are all important components that constitute personal food preferences. Of those categories, some showed more genetic influences, while others show more environmental influences which is subject to potential changes.

Keywords: Food preference, Dietary intake, Picky eating, Heritability, Genetic-environmental structure, Shared environment

Student Number: 2016-24017

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Chapter 1

Introduction

Dietary intake is important in determining health status, and many factors have been known to be related with food intake (e.g. individual, sociocultural, environmental factors) [1]. From a perspective of individual food choices, how people choose what to eat is influenced by one's food preference [2]. For example, picky eaters usually show a strong distaste against certain food group, which leads to different eating habit [3,4]. Since nutritional problem is changing from the past that unbalanced diet is getting more importance than nutrient deficiency [5], considering individual aspects of eating behavior is essential in nutritional epidemiology, and food preference plays a key role in determining one's eating habit [6].

Determinants of food preference have been studied in different perspectives [7–9]. Sensory systems are primary factors, for example, taste and olfaction [10,11]. Different kinds of taste (e.g. bitter, sweet, salt, etc.), olfactory, and tactile receptor are responsible for the identification of nutrients in food [10,12]. Chemical detection to energy-dense or poisonous contents enables the recog-

nition of nutritious or toxic nutrients, which contributes healthy and disease status [13]. Therefore, many genetic analyses have been undergone [14–21], and recent studies have conducted genome-wide association analyses (GWAS) on food likings [22, 23]. It is widely known that sensory perception differs between individuals [24], and genetic variation regarding odor, bitter, and sweet receptors have been reported [25, 26].

Besides from biological and genetic perspectives in food preference, the effects of age and weight status are suggested in many studies [27–32]. Eating behavior like picky eating or food fussiness in childhood have been studied widely [29,31], which illustrates the importance of early eating habits regarding adult-onset obesity. Maternal effects, for example child-raising practices [33,34], are known to be related to the determination of food preference in early childhood. But due to cultural and social influences in adolescence and adult [35], personal experiences or environmental settings may change preferences and make different food choices [30, 32].

Twin studies have established the analysis of genetic-environmental structure, and were conducted in many countries among childhood and adults [36–44]. Estimates of heritability in childhood show high impact of genetic influences [37–39, 41, 42], but food preferences may vary among adults and children/adolescence due to the environmental components [40,43,44]. Also, shared environment (e.g. being raised together, cohabitation, etc.) also exists [38, 40, 42, 45], indicating the importance of food environment in developing personal eating behaviors.

However, to our knowledge, there are no studies of the general description of food preference in large population using an open-form questionnaire [46]. Only closed-form has been used, and many studies have only focused on food likings [38,40,41]. However, overall categorization of food preference, especially

like food distaste, is the major step of understanding eating behaviors, and still remains undiscovered.

Therefore, the purpose of this study is to understand general characteristics of food preference in adult Korean using an open-form questionnaire. Also, genetic-environmental influences are analyzed to find out whether food preference is innate or shared environment effect exists.

Chapter 2

Materials and Methods

2.1 Participants and Data Collection

The Healthy Twin Study is a twin-family cohort study of Korean, involving adult twins and their first-degree relatives. Since 2005, total 3500 participants have been recruited and undergone health examination. Among 3500 cohort subjects, 1029 individuals completed 'Well-being and Mental Health Questionnaire' from 2013 to 2015, in hospital or by mail. There were 2 open questions about food preferences (distaste, fondness). Participants were asked to name food up to 3 items.

Dietary intake was also examined using food frequency questionnaire (FFQ), and 3-day food record. FFQ was semi-quantitative for 106 food items, and nutrient intake was calculated through 3-day food record. Both diet surveys were conducted repeatedly at maximum 3 times.

12-7. 남들은 대부분 잘 먹는데, 신념이나 가치 때문이 아니라 식성과 맛 때문에 특별히 싫어해서 못 먹는 음식이 있습니까? (예: 오이, 버섯, 쇠고기 등)

① 없다 ② 있다 (있다면 3개까지 _____ , _____, _____)

12-8. 있다면, 가족 중에도 같은 식성을 가진 분이 있습니까?

① 없다 ② 있다 (있다면 누구인가요? _____ , _____, _____)

12-9. 남들은 싫어하는 사람도 많은데 (뱀, 보신탕 등 혐오 식품 제외), 본인은 오히려 상당히 좋아하시는 음식이 있습니까? (예: 고수나물 (베트남 음식의 향), 삭힌 홍어, 쇠간 등)

① 없다 ② 있다 (있다면 3개까지 _____ , _____, _____)

12-10. 있다면, 가족 중에도 같은 식성을 가진 분이 있습니까?

① 없다 ② 있다 (있다면 누구인가요? _____ , _____, _____)

Figure 2.1 Food Preference Questionnaire

Box 1. Well-being and Mental Health Questionnaire

Question 1 : Food Distaste

Do you have any particular food which you hate to eat

but most people enjoy or routinely eat? (up to 3 items)

- Please exclude what you don't eat due to religious or personal values.
- Please focus on what you hate to eat because of the food itself.
- For example, cucumber, mushroom, beef, etc.

Question 2 : Food Fondness

Do you have any particular food that you like

although many people seem to hate it? (up to 3 items)

- Please exclude 'weird' food (e.g. dog meat, snake)
- For example, cilantro, Vietnam cuisine, fermented skate, beef liver, etc.

2.2 Statistical Analyses

First, by using the open-form food preference questionnaire, each food item was classified into an appropriate category which was predetermined by committee. Second, whether responding certain food item or not was treated as binary, and participants were grouped according to the food items they answered. Third, sex-age structure was analyzed for each group. Proportion of respondents was compared between sex and age group for each food preference group (proportion test, chi-square test). Fourth, to find out genetic-environmental influences on food preference, heritability ($h2$) and shared environment effects ($c2$) were calculated using variance component model adjusting sex, age, age^2, and its interaction term in SOLAR software. Also, intraclass correlation coefficients (ICCs) were calculated in S.A.G.E. software (monozygotic twin (MZ), sibling (SIB), parent-offspring (PO), spouse (SPS)).

Chapter 3

Results

3.1 Descriptive Epidemiology

Total 1029 adult koreans participated in the survey and their baseline characteristics are shown in Table 3.1. Monozygotic twins are 154 pairs with 653 non-twins. Proportion of female is 61.2% and average age is 49.6 $\pm$ 14.1.

962 food items were responded by 372 subjects (36.2%); 625 items for food distaste by 270 participants and 337 items for food fondness by 167 participants (Table 3.2). Average 2.3 and 2.0 food items for food distaste and fondness were answered. The proportion of answering 3 food items was 51.5% in food distaste, and 36.5% in food fondness.

Table 3.1 Baseline Characteristics of Participants

	Men ($n = 399$)	Women ($n = 630$)	All ($n = 1029$)
Food Preference, n(%)	129 (32.3)	243 (38.6)	372 (36.2)
Dislike	80 (20.1)	190 (30.2)	270 (26.2)
Like	69 (17.3)	98 (15.6)	167 (16.2)
Dislike & Like	20 (5.0)	45 (7.1)	65 (6.3)
Monozygotic twin, n(pair)	92 (46)	216 (108)	308(154)
Age	50.2 ± 14.8	49.2 ± 13.6	49.6 ± 14.1
BMI (kg/m2)	24.6 ± 3.0	23.2 ± 3.5	23.7 ± 3.4
Waist Circumference (cm)	86.7 ± 8.2	79.5 ± 9.1	82.3 ± 9.4
Smoking (%)			
Never	31.5	94.5	70.2
Current	33.5	3.2	14.9
Socioeconomic (%)			
≥ \$2000 per month	53.4	52.9	53.1
≥ College	42.3	31.9	35.9
Dietary Intake			
Energy (kcal)	1970.5 ± 728.0	1678.3 ± 931.3	1786.4 ± 872.7
Carbohydrate (g)	340.6 ± 130.2	288.0 ± 137.1	307.4 ± 136.9
Protein (g)	65.5 ± 28.3	56.9 ± 44.6	60.1 ± 39.5
Fat (g)	35.8 ± 19.9	31.6 ± 34.7	33.2 ± 30.1
Sodium (mg)	2498.4 ± 1456.2	2158.0 ± 1529.3	2283.9 ± 1510.8

Table 3.2 Responses in the Food Preference Questionnaire

	Distaste	Fondness
Number of Food items	625	337
Number of Respondents	270	167
3 items (%)	139 (51.5)	61 (36.5)
2 items (%)	69 (25.5)	48 (28.7)
1 item (%)	62 (23.0)	58 (34.8)
Average	2.3 items	2.0 items

3.1.1 Categorization of Food Preference

Food preference can be categorized into 4 groups with several subgroups — olfaction/aroma (*Olfaction*), texture/consistency (*Texture*), emotional or psychological disgust (*Disgust*), other specific food items (*Others*) (Table 3.3). For some categories, it is subdivided into several subgroups; *Olfaction* (*fishy*, *flavor*), *Disgust* (*meat-unconventional*, *offal*).

Olfaction is a category related to specific odor that contributes personal preferences. For *fishy* subgroup, most were seafood, and *flavor* subgroup included cucumber, cilantro, etc.

Texture is another sensory factor but it is rather mouth feel, which is different from standard 5 tastes. (e.g. mushroom, eggplant, oyster, etc.)

For *Disgust* category, it is related to emotional or psychological factors, not the sensation. It can be subdivided into *meat-unconventional* and *offal* subgroups. *meat-unconventional* is a group of animal meats that are not commonly consumed (e.g. dog, snake, horse, etc.). Animal meats except beef, pork, chicken are classified into *meat-unconventional*. For *offal*, it is a group of organ meats

that are usually made from pig or cow, which is commonly consumed in Korea. It includes Sundae (Korean sausage), liver of cow, intestine and stomach of cow or pig, etc.

Specific food items which are not grouped into above categories are classified as *Others*. This type of food items has their own unique characteristics that contribute strong preferences among people. For example, *meat-conventional* (e.g. beef, pork, chicken), *fermented skate* (strong ammonia-like odor), and *cilantro* (cilantro, cuisine of Vietnam, Indian, or Chinese) are included.

3.1.2 Grouping of Food Preference

After categorization of food preference, participants were grouped according to the food items they responded (Table 3.4). Both food distaste and fondness groups were made to each category, but due to the characteristics of questionnaire, commonly consumed foods were not responded completely in food fondness question. Therefore, only food fondness for *Olfaction*, *offal*, *fermented skate*, *cilantro* was grouped for further analyses.

For food distaste, the most responded category was *Olfaction* (n=126), with *fishy* (n=65) and *flavor* (n=69) subgroups. Also, not only due to the olfactory factors, mouth sensation was evident in determining one's food choice; *Texture* (n=70). Besides sensory mechanisms, psychological factors were second main determinants; *meat-unconventional* (n=52), *offal* (n=63), *meat-conventional* (n=56).

In food fondness, the major single food item was *fermented skate* (n=83). Also, *offal* category was predominant together with *fermented skate*, which both have a distinct characteristic compared to other cuisine.

Table 3.3 Categorization and Classification of Food Preference

Category	Subgroup	Food item examples
Olfaction	all	
	fishy	seafood, fish, sliced raw fish (sashimi), oyster, shellfish, crab, salted seafood
	flavor	cilantro, mugwort, water parsley, spice, curry, cuisine of India/China etc.
		chili, garlic, onion, ginger
		deodeok (Codonopsis lanceolata), balloon flower root (Platycodon), ginseng
		mushroom, cucumber, cheese
Texture	all	eggplant, mushroom, knee cartilage of a cow, taro
		oyster, sliced raw fish (sashimi), shellfish, seaweed
		boiled vegetables (e.g. carrot, radish)
Disgust	*offal*	liver, blood curd, lung, Korean Sausage (Sundae)
		tripe, chitterlings, entrails, cow heart, omasum, cartilage
		chicken feet, loach, eel
	meat-unconventional	dog meat food, whale meat, snake, horse, goat, rabbit, frog, etc.
Others	*meat-conventional*	cow, pig, chicken, duck, lamb
		meat, lard, other meat dishes (e.g. boiled pork (Bossam), ham)
	fermented skate	fermented skate (Hongeo)
	cilantro	cilantro, mugwort, water parsley, spice, curry, cuisine of India, China etc.

Table 3.4 Distaste and Fondness Group in Food Preference Categories

Category	Subgroup	Distaste, n(%)	Fondness, n(%)
Olfaction	all	126 (12.2)	62 (6.0)
	fishy	65 (6.3)	-
	flavor	69 (6.7)	-
Texture	all	70 (6.8)	-
Disgust	*offal*	63 (6.1)	65 (6.3)
	meat-unconventional	52 (5.1)	-
Others	*meat-conventional*	56 (5.4)	-
	fermented skate	-	83 (8.1)
	cilantro	-	32 (3.1)

3.1.3 General Characteristics of Food Preference

For overall food preference, the proportion of people who answered 'yes' on food distaste was higher in women than men (30.2% vs 20.1%, $P < 0.001$). Whereas, the difference in proportion between sex was not significant in food fondness (Figure 3.1).

In food distaste, *Olfaction* and *Texture* group did not show the difference, but *offal* and *meat-conventional* group was significant that women reported more than men (3.5 vs 7.8%, 2.8 vs 7.1%; $P < 0.001$). However, in food fondness, the proportion of men who had fondness for *fermented skate* was higher than that of women (10.5 vs 6.5%, $P < 0.05$).

Age distribution of food distaste and fondness is shown in Figure 3.2 and Figure 3.3. First, for overall food preference, food distaste shows a decreasing pattern along age group ($P < 0.05$), but food fondness did not. Second, younger people showed more distaste for *Olfaction* and *Texture* and their related subgroups, with the proportion of respondents decreased along age. Third, distaste for *offal* showed an decreasing trend with age group ($P < 0.05$), but *meat-unconventional* and *meat-conventional* were rather constant. Fourth, in case of food fondness, it showed less difference across age group compared to food distaste, but only *cilantro* showed a significant difference across age group ($P < 0.05$).

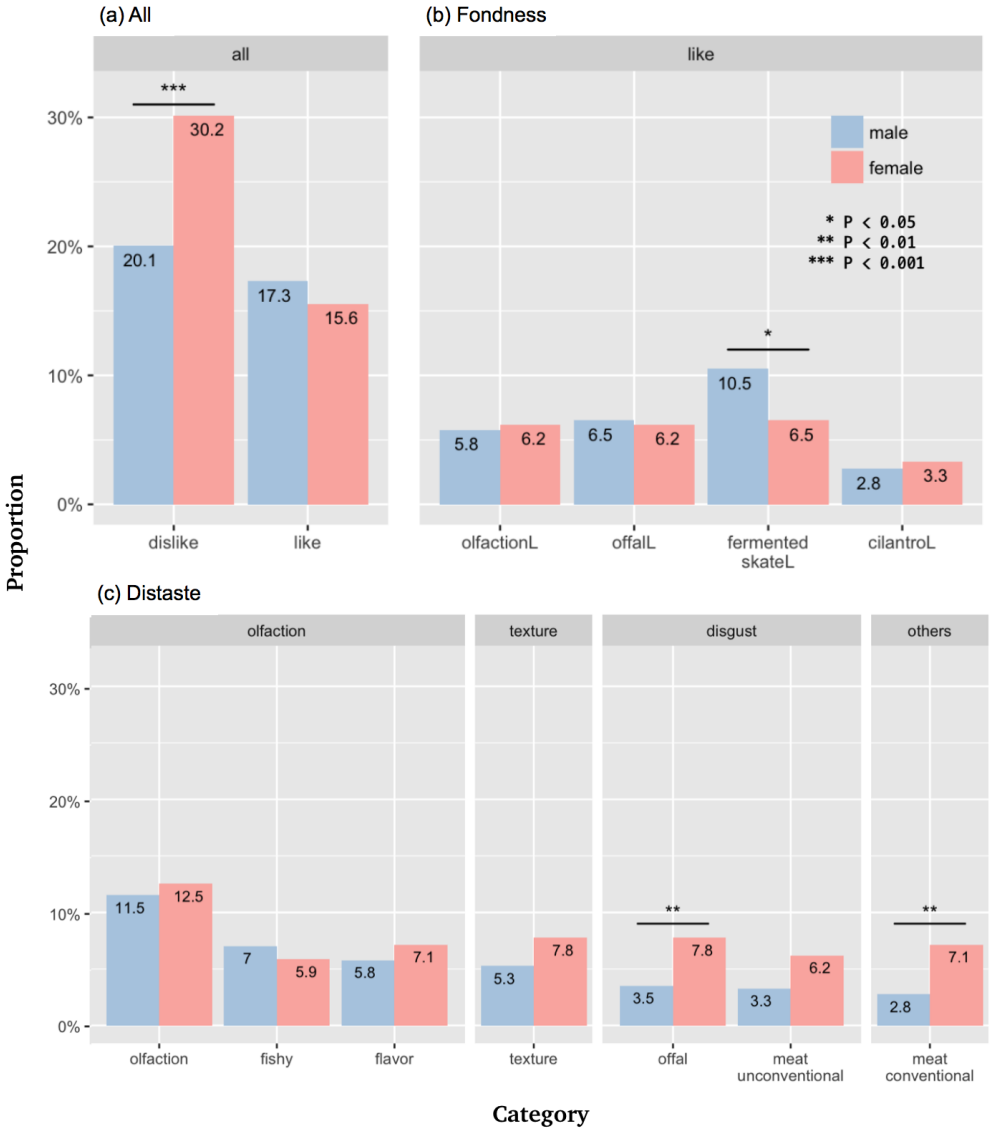

Figure 3.1 Proportion of respondents by sex

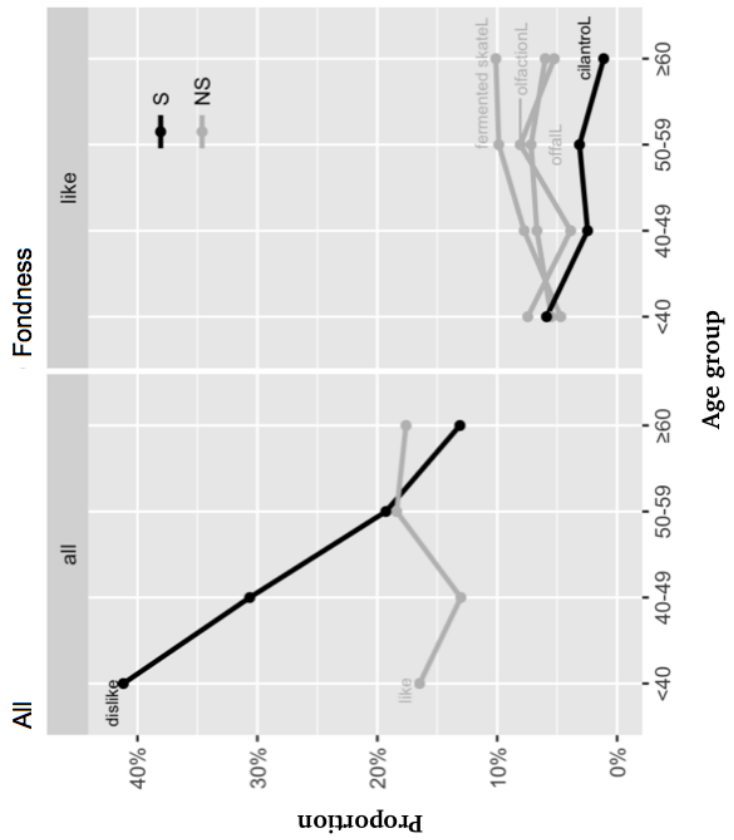

Figure 3.2 Proportion of respondents by age group (All & Fondness)

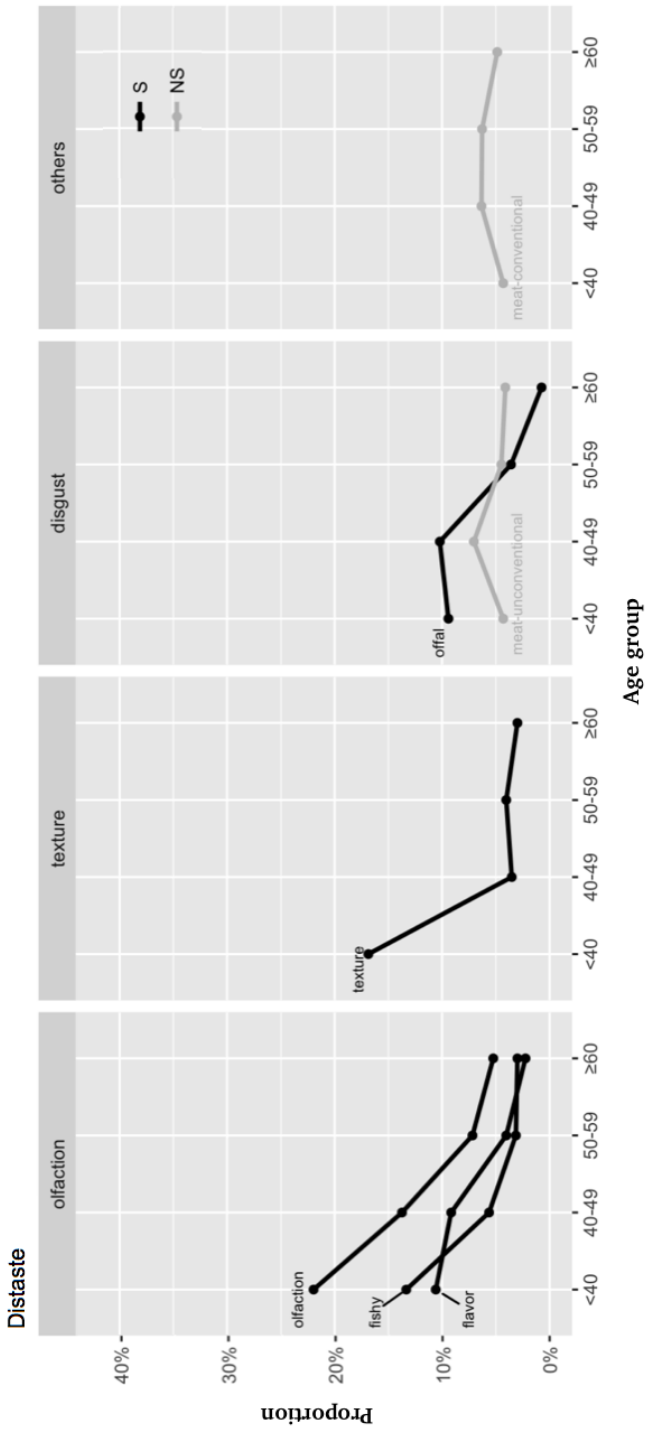

Figure 3.3 Proportion of respondents by age group (Distaste)

3.2 Genetic-Environmental Influences

Heritability and ICCs are shown in Table 3.5 and Table 3.6. Some categories for food distaste showed genetic influences; *Olfaction* and *Texture* ($h2$: 0.41, 0.48). Subgroups for *Olfaction* were also heritable — *fishy* ($h2$: 0.51), *flavor* ($h2$: 0.45). For *flavor* distaste, shared environmental effect, specifically spousal effect was also evident ($c2$: 0.55), which is also compatible with ICCs (SPS: 0.265, MZ: 0.217).

Other dimensions, for example, *Disgust* or *meat-conventional*, did not show the evidence of genetic influences. Rather, only shared environments explained distastes for *offal* ($c2$: 0.33, SIB: 0.158), *meat-unconventional* (SPS: 0.207) and *meat-conventional* (SPS: 0.308, MZ: 0.191).

For food fondness, all categories were heritable; *Olfaction* ($h2$: 0.43), *Offal* ($h2$: 0.36), *fermented skate* ($h2$: 0.27), *cilantro* ($h2$: 0.68).

Table 3.5 Heritability of Food Preference Categories[1]

Category	Subgroup	N	$h2 \pm s.e.$	$c2 \pm s.e.$	Best-fitting model[2]	
Distaste						
Olfaction	all	126	0.41 ± 0.11	-	AE	
	fishy	65	0.51 ± 0.15	-	AE	
	flavor	69	0.45 ± 0.14	0.55 ± 0.14	ACE	(spouse)
Texture	all	70	0.48 ± 0.16	-	AE	
Disgust	*offal*	63	-	0.33 ± 0.19	CE	(sibling)
	meat-unconventional	52	-	-	E	
Others	*meat-conventional*	56	-	-	E	
Fondness						
Olfaction	all	62	0.43 ± 0.18	-	AE	
Disgust	*offal*	65	0.36 ± 0.15	-	AE	
Others	*fermented skate*	83	0.27 ± 0.01	-	AE	
	cilantro	32	0.68 ± 0.20	-	AE	

[1] h2, heritability; c2, shared environment effects; s.e., standard error

[2] AE: additive and unique environment; ACE: additive, shared environment and unique environment; E: unique environment

Table 3.6 Intraclass Correlation Coefficients of Food Preference Categories[1]

Category	Subgroup	MZ (154pairs)	DZ+SIB (455pairs)	PO (728pairs)	SPS (116pairs)
Distaste					
Olfaction	all	**0.196 ± 0.078**	**0.114 ± 0.052**	**0.123 ± 0.041**	0.040 ± 0.106
	fishy	**0.251 ± 0.076**	**0.120 ± 0.055**	**0.083 ± 0.041**	-0.038 ± 0.091
	flavor	**0.217 ± 0.077**	0.096 ± 0.052	**0.094 ± 0.043**	**0.265 ± 0.127**
Texture	all	**0.358 ± 0.071**	0.062 ± 0.049	**0.131 ± 0.049**	-0.036 ± 0.105
Disgust	*offal*	0.006 ± 0.081	**0.158 ± 0.057**	0.005 ± 0.039	-0.012 ± 0.124
	meat-unconventional	-0.055 ± 0.081	-0.007 ± 0.044	0.069 ± 0.038	**0.207 ± 0.089**
Others	*meat-conventional*	**0.191 ± 0.078**	0.081 ± 0.051	0.031 ± 0.041	**0.308 ± 0.096**
Fondness					
Olfaction	all	**0.473 ± 0.063**	-0.056 ± 0.061	**0.110 ± 0.052**	0.125 ± 0.092
Disgust	*offal*	0.131 ± 0.08	0.080 ± 0.054	0.029 ± 0.041	0.003 ± 0.102
Others	*fermented skate*	0.038 ± 0.081	0.036 ± 0.055	0.049 ± 0.039	0.124 ± 0.092
	cilantro	**0.487 ± 0.062**	**0.116 ± 0.055**	**0.107 ± 0.052**	-0.032 ± 0.092

[1] MZ, monozygotic twins; DZ, dizygotic twins; SIB, siblings; PO, parent-offsprings; SPS, spouses

Chapter 4

Discussion

4.1 Summary

Our findings indicate that food preferences in adult consist of various multisensorial and psychosocial factors, far beyond basic simple tastes. Sensory factor like olfaction and mouth sensation is one of the main components, but psychosocial and cultural factors are also crucial when personal food preference is determined. Some categories (e.g. distaste in *Olfaction*, *Texture*) showed more genetic influences, but other categories in food preference can be constituted during childhood (sibling effect), or changed throughout the lifetime (cohabitation). Generally, for food distaste, there is a decreasing trend across the age group, which is compatible with previous findings on picky eating in childhood [4, 30].

The decreasing pattern across age group was notable in food distaste — the younger reported more about food distaste against *Olfaction*, *Texture*, *offal* categories. There are two possible explanations. First, the loss of sensory

perception ability in elderly is widely known [47–49], and *Olfaction*, *Texture* categories are the ones that are closely related to the olfactory and textile stimuli. Second, personal experiences may influence the change in food preference, especially distastes in novel foods [50–53]. For example, novelty seeking [52, 54] or food neophobia [4, 55, 56] have been studied in picky eating behaviors. As more various dietary patterns are experienced, some unusual foods in early age can be changed into familiar items [53].

In this research, food preferences were categorized into 4 groups with several subgroups by using an open questionnaire. Considering that many researches have been conducted with closed questionnaires [38, 40, 42], and that only basic tastes factors are generally included, our study illustrates the importance of other psychological factors (*Disgust*, *meat-conventional*, and *meat-unconventional*) beyond sensory components (*Olfaction*, *Texture*).

Disgust category (*offal*, *meat-unconventional*) had similar characteristics with *meat-conventional* group. Proportion of female was high (75-80%) among these categories, and also are highly impacted by environmental factors. Specifically spousal ICC was evident that cohabitation, and spousal effect is the main factor, which contributes the changes in food preference in adulthood.

Whereas psychological categories showed shared environmental influences, groups with sensory perception (*Olfaction* and *Texture*) were more influenced by genetic components. It implies that the food preference related to biological receptors has innate features, which in turn, different dietary advices should be given to picky eaters compared to other food groups.

4.2 Implication

Understanding the food preference in population level provides a new perspective on individual food choices, which lead to different eating behavior and dietary intake (e.g. picky eating, unbalanced diet). Unbalanced diet is one of the major health problems in public health [57]. As nutritional problems are changing from malnutrition to the unbalanced diet [57], individual choices on food items have higher impacts on the determination of health and disease status. Therefore, it is important to give proper dietary advices to different groups, and they can be given based on the characteristics of each group.

Food preference categories with genetic influences can be considered innate (e.g. *Olfaction*, *Texture*), implying it is harder to be changed. In this case, it would be ineffective to provide simple nutritional advices like just increasing the consumption of certain food. Rather, suggesting an alternative food item is needed, and this can be the basis of personalized nutrition in the precision medicine era.

For others categories that showed environmental influences (e.g. distaste in *Disgust* and *meat-conventional*), nutritional education program (sibling effect) or changing eating environments (cohabitation or spouse effect) can be effective, which focuses on the changing of current eating habits.

By combining the new perspectives on public health, the prevention of nutritional problem can be effectively implemented through the personalized dietary advices on different food preference groups.

4.3 Strength

Categorization was a major step in this study that provides overall features of food preferences in Korean and enabled participants to be grouped accordingly. Interestingly, our study illustrates the importance of other psychological factors (*Disgust*, *meat-conventional*, *meat-unconventional*) beyond sensory components (*Olfaction*, *Texture*). By using this category, it could be used as the baseline of closed-form questionnaire in further studies, especially for Koreans. For other countries, on the other hand, classification of food group is needed to map items into the appropriate categories.

Besides, due to the open question used in this study, participants were able to grouped accordingly. Especially, food distaste is not highly suggested in other studies, but only food likings are the main metrics using food liking scale [38, 40, 42]. Considering that food choice and eating habit is not only influenced by fondness of certain food, picky eating is also the major issue in unbalanced diet [3, 30]. Analysis on food distaste will provide a way of general understanding in the role of food choices and eating behavior in nutritional problems.

Also for unusual novel food (*Disgust*), estimation of heritability and ICCs is the first genetic analyses conducted in food preference studies. Distaste against this psychological category was rather environmental compared to sensory categories. However, food fondness for *Disgust* showed genetic influences, so the further studies are needed to understand the general characteristics of food preference.

4.4 Limitation

General food items and some food groups were not answered in the study due to the features of open questionnaire. Participants were asked to name food openly, but with some explanations and exclusions. With certain instruction provided by researchers, it was possible to get specific items which is unique to personal food preference, not the palatable food items in food fondness (e.g. pizza, ice cream, candy, etc.). However, they were specifically asked to name 'routinely eaten food in population' in food distaste and 'hated food' in food fondness. For this reason, certain food groups were excluded from the responses. And the modest size of our study ($n = 1029$) did not allow more detailed categorization of food preferences.

Also the traits were considered as binary, but still 'not responded' does not mean 'no distaste or fondness' exclusively. Cultural and dietary experiences can differ across age groups — the younger may have fewer chances to experience to *fermented skate*. In this case, there is a possibility of bias that certain food groups might not have been reported in certain age groups. Also, this survey was cross-sectional and the age trend might include birth cohort effects other than true age effect.

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초록

식이섭취상태는 건강과 질병 상태에 영향을 미치는 주요 결정요인 중 하나로, 사회문화적, 환경적 요소 등이 복합적으로 작용하고 있다. 그러나 식품 선택을 좌우하는 개인적 측면의 식이섭취상태는 밝혀진 바가 거의 없으며, 이는 현대의 영양문제가 과거와는 다르게 편식과 불균형한 식습관에서 기인한다는 점에서 연구의 필요성이 존재한다. 따라서 본 연구를 통해 식이선택을 좌우하는 요소 중 하나인 식이선호도의 특성을 파악하고자 한다. 한국인 성인을 대상으로 각 범주 및 집단별 분포 양상과 유전-환경 구조를 분석하고자 한다.

쌍둥이와 직계가족이 포함된 성인 1029명을 대상으로 식이선호도에 대한 설문을 진행하였다. 여성은 61.2%, 연령은 만 17세부터 87세까지 전연령대에 걸쳐 분포되어 있으며, 일란성 쌍둥이는 154쌍이다. 주관식 설문을 통해 얻은 식품을 바탕으로 범주화 및 분류화 작업을 진행하였으며, 이를 바탕으로 형성된 집단별 연령-성별 분포 양상을 분석하였다. 또한 유전율($h2$)과 급내상관계수(ICC)를 계산하여 유전-환경 구조를 파악하였다. 환경적 요소의 경우, 더나아가 거주상태/형제자매쌍/부부쌍으로 나누어 공유된 환경의 영향($c2$)이 존재하는지 분석했다.

그 결과, 한국인 식이선호도는 크게 4가지(냄새류, *Olfaction*; 식감류, *Texture*; 비위류, *Disgust*; 기타, *Others*)로 범주화가 가능하며, 그 외 하위 범주가 존재한다. 성별 분포의 경우 일반적인 육류와 비위류는 여성에서 기피 응답 비율이 높았으며, 연령의 경우 냄새류와 식감류 집단에서 연령층이 어릴수록 해당 식품의 기피 응답 비율이 높았다.

기피 음식의 유전-환경 구조 분석 결과, 냄새류와 식감류 집단은 유전적인 특성을 보였다($h2$: 0.41, 0.48). 향류의 경우, 유전적인 특성과 함께 공유된 환경의 영향($c2$: 0.55)이 나타난다. 반면 내장류($c2$: 0.33)와 비일반적인 육류, 일반적인 육류(spouse ICC: 0.207, 0.308)의 경우에는 유전적 영향보다는 공유된 환경의

영향만이 존재했다. 반면, 선호 음식의 경우에는 유전적인 특성을 나타냈다($h2$: 0.27-0.68).

본 연구를 통해서 한국인 성인의 식이선호도는 단순히 기존에 알려진 미각에 의한 것만이 아님을 나타낸다. 냄새와 향 외에도 식감이라는 입 안의 촉감과 그 외에도 심리적 요인이 중요하게 영향을 미치며 개인의 식이선호도 및 식습관을 형성한다. 이때, 각 범주는 고유의 유전적, 공유된 환경 구조를 가지고 있으며, 연령군에 따라 양상이 다르다는 점에서 변화가 가능함을 보여준다.

주요어: 식이선호도, 식이섭취, 편식, 유전율, 유전-환경구조, 공유된 환경
학번: 2016-24017